



AMS Tracker Thermal Control Subsystem

TTCB EMC/EMI operation procedure

AMSTR-NLR-PR-029

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Document change log

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1 Scope of the document and test objective

During EMC/EMI test components of the TTCB need to operational. This document contains operation procedure sheets for the TTCB during EMC and EMC and does not include the EMC/EMI test procedure.

2 Hardware under test

The hardware the TTCB-p or TTCB-s are the flight modules. The TTCB shall be operational during EMC/EMI test and therefore will be connected to Ground Support Equipment to form a closed loop filled with CO₂. The GSE-loop will be equipped with a mass flow meter, absolute pressure transducer, differential pressure transducer and temperature sensors.

3 Test Requirements

During the emissivity test the following actuator will be switched on to measure the emission. If possible the actuators will be switched on separately, no other actuators active or as less as possible.

	Actuator	Pump running	comment
1	Peltier elements	no	PWM, TBD %
2	Accumulator heater FAC	no	PWM, , TBD %
3	TTCB pump	yes	3500, 6000, 10000 RPM
4	Pre-heater	yes (minimal flow)	Auto control
5	Start Up Heater	yes (minimal flow)	Manual ON/OFF (2s/10s)
6	Cold Orbit Heater	yes (minimal flow)	Manual ON/OFF (2s/10s)

4 Test facility/equipment description

The test is performed at SERMS (Terni) at the EMC/EMI test facility and the following type of equipment will be used for operating the TTCB:

- TTCE / cables / CAN-if / pc with TTCE sw
- CO₂
- Mass flow meter
- Absolute transducer

- Differential pressure transducer
- Temperature sensors, TC type T
- NI cDAQ system
- Pc with LV sw
- Thermostat bath for cooling CO₂ (GSE-loop)

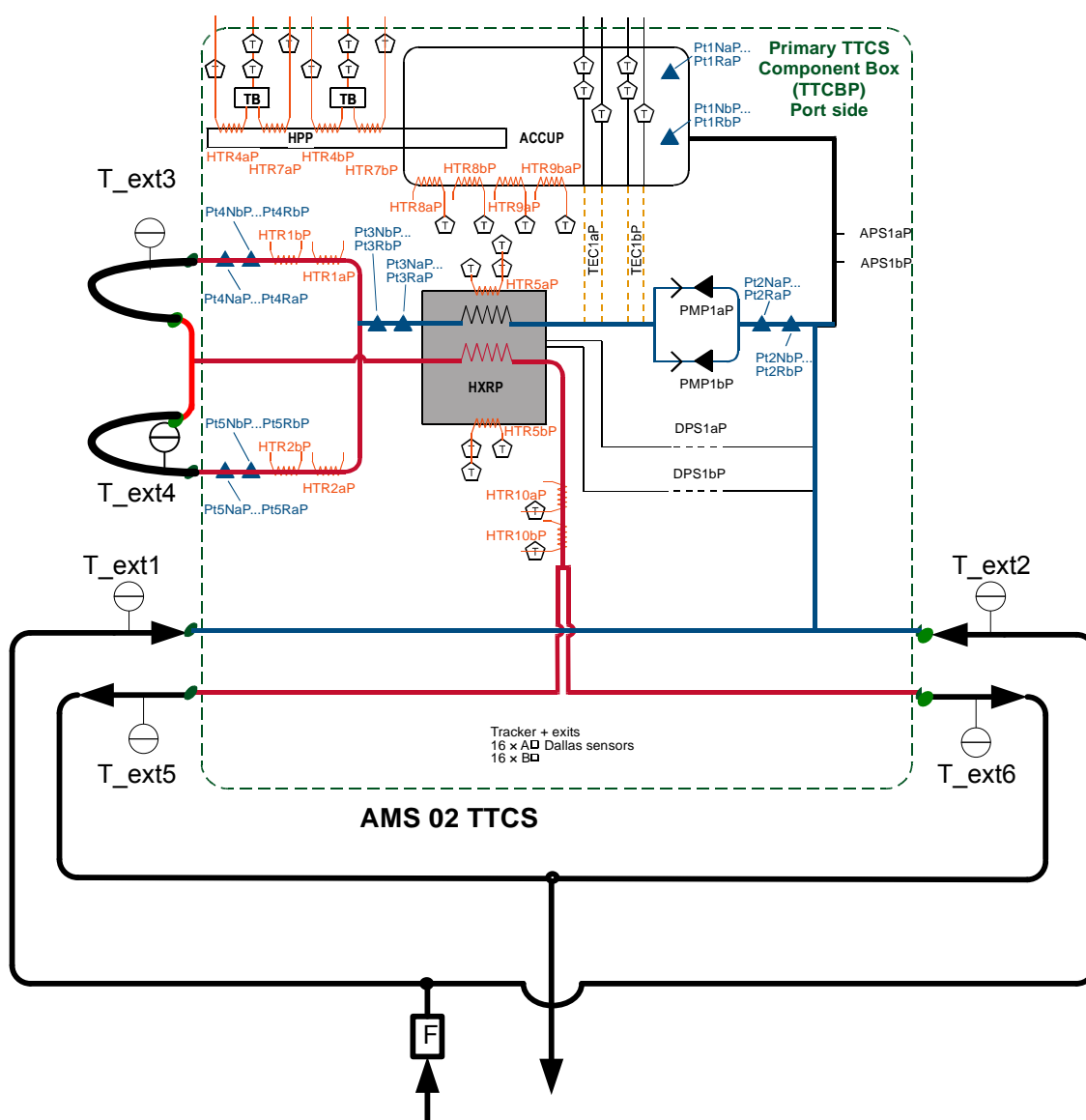


Figure 4-1: TTCB schematic with additional tubing for functional test



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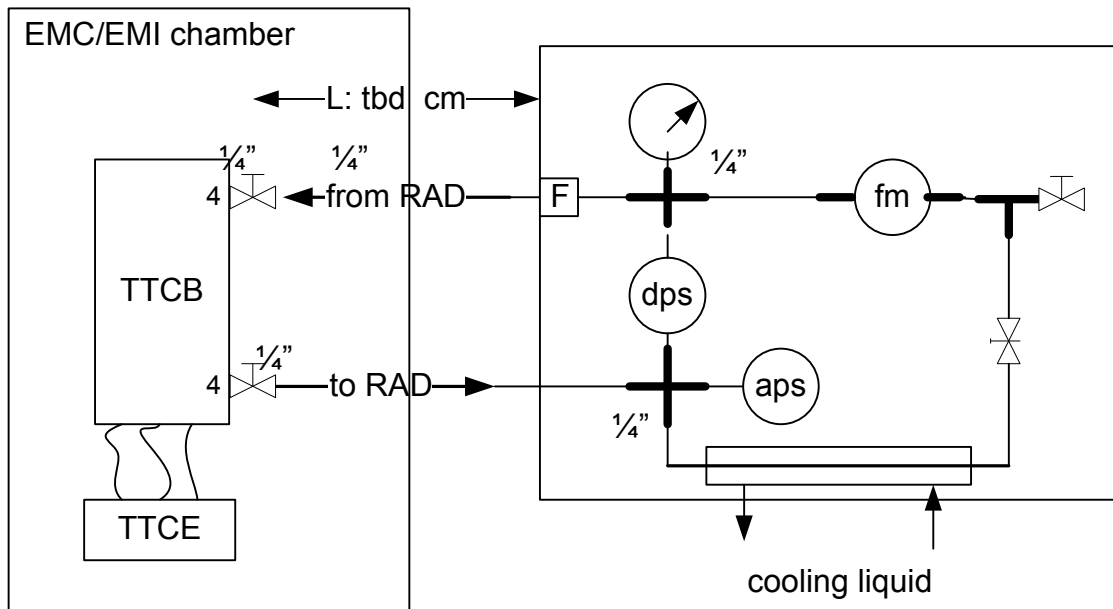


Figure 4-2: schematic with GSE for operating TTCB



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5 TTCB EMC/EMI Test in main steps

The main test steps are:

1. Fill the system with CO₂, TTCB inside climate chamber and GSE outside climate chamber
2. Separate TTCB and GSE-loop for transport to EMC facility and connect the TTCB and GSE-loop in EMC facility.
3. Connect TTCB to TCCE
4. Operate TTCB and conduct EMC/EMI test
5. Empty TTCB
6. Dis-connect TTCB from TCCE

6 References documents

	Title	Number	Date
RD-1	TTCS Requirements Verification Matrix FM H/W	AMSTR-NLR-PL-02 Issue 1.0	April 2007
	Filling procedure		



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7 TTCB EMC/EMI operation procedure

7.1 The TTCB EMC/EMI operation procedure

The TTCB EMC/EMI operation procedure sheets shall be filled in, and shall accompany the TTCB during it's lifetime in order to be able to show the procedure was followed.

During the EMC/EMI test the environment can not be cooled. Therefore it might be necessary to pause in between the EMC/EMI test steps to condition the environment or cool down the TTCB itself for safe operation of the TTCB actuators. The procedure has been written assuming an environment temperature of 20 °C or lower and humidity as low as possible.



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7.2 TTCB EMC/EMI preparation sheet

	TTCB EMC/EMI preparation procedure sheets		company:		date:	
	Fill in by hand.		engineer:		location:	
Step	Action	Monitoring	Value	Result	Comment	√
1.	Record model type		P / S / QM			
2.	Cool down EMC chamber, Tenviroment	Tenviroment	$T \leq 20^{\circ}\text{C}$			
3.	Place TTCB in climate chamber and GSE outside climate chamber					
4.	Wrap TTCB completely in plastic foil, as leak tight as possible					
5.	Flush TTCB envelop with gN2, to remove moisture					
6.	Fill system with CO2 with DPS bypass valve open	Fill rate	TBD g/liter			
7.	Close TTCB connection valves and disconnect GSE					
8.	Verify EMC chamber temperature	Tenviroment	$T \leq 20^{\circ}\text{C}$			
9.	Transport to EMC/EMI test facility					
10.	Place TTCB in EMC chamber, GSE outside chamber and connect tubing and TTCE.					
11.	Put thermal insulation around connection tubes					
12.	Vacuum GSE using dry scroll pump	time	5 min			



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	TTCB EMC/EMI preparation procedure sheets		company:		date:	
	Fill in by hand.		engineer:		location:	
Step	Action	Monitoring	Value	Result	Comment	√
13.	Purge GSE-loop with CO ₂ . Open a TCB connection valves slowly for a few seconds.	pressure	P > 5 bar			
14.	Vacuum GSE using dry scroll pump	time	5 min			
15.	Open both TTCB connection valves slowly.					
16.	Close DPS bypass valve					
17.	Switch on thermostat bath and set Tsetpoint	Tther.bath	T= 10 °C			
18.	End of sheet					
19.						
20.						
21.						
22.						



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7.3 TTCB EMC/EMI operation procedure sheets

	TTCB EMC/EMI operation procedure sheets		company:		date:	
	Fill in by hand.		engineer:		location:	
Step	Action	Monitoring	Value	Result	Comment	√
1.	Record model TTCB	model	P			
2.	Verify TTCB Tenvironment	Tenvironment	$T \leq 20^{\circ}\text{C}$			
	Peltier test					
3.	Switch on thermostat bath, set Tsetpoint	T cooling liquid	$T_{\text{bath}} = 5^{\circ}\text{C}$			
4.	Set / control Taccu to 23°C	Pt01	$Pt01 = 23^{\circ}\text{C}$			
5.	Switch on TTCB pump for 10 min. for cooling down TTCB tubes	RPM, massflow	5000, $\sim 2.2\text{ g/s}$			
6.	Switch off accu heaters					
7.	Execute “ EMC accu peltier test ”, monitor Tcopper saddle & system pressure. (switch on peltier TBD %)	DS07 DS08 pressure	$DS07 < 25^{\circ}\text{C}$ $DS08 < 25^{\circ}\text{C}$ $P < 65\text{ bar}$			
8.	If Tcopper saddle or pressure too high then stop “EMC accu peltier test” and repeat step 4 – 6 for cooling down TTCB hw and / or cool down EMC test chamber and continue test					
	Heat pipe heater test (FAC)					



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	TTCB EMC/EMI operation procedure sheets		company:		date:	
	Fill in by hand.		engineer:		location:	
Step	Action	Monitoring	Value	Result	Comment	√
9.	Set accumulator set point, automatic control	Taccu	T=Tenv + 2 °C			
10.	Switch on TTCB pump for cooling down TTCB hw	RMP , Tloop	5000 RPM Tloop stable			
11.	Set accumulator set point, automatic control	Taccu	T=Tenv - 2 °C			
12.	Wait until Tacc = Tsetpoint	RMP , Pt01, Tloop	5000 RPM Pt01=Tsetpoint Tloop stable			
13.	Switch off pump	RPM	0			
14.	Execute “ EMC accu FAC test ”, monitor Taccu & system pressure. (switch on FAC TBD %)	Pt01 pressure	Pt01< 25°C P < 65 bar			
15.	If Pt01 or pressure too high then stop “EMC accu FAC test”, cool down EMC test chamber, repeat step 9 – 13 for cooling down TTCB hw and continue test	Tenv	Tenv ≤ 20°C			
	Pump test					
16.	Set accumulator set point, automatic control	Taccu	T=Tenv °C			
17.	Switch on TTCB pump for cooling down TTCB hw	RMP , Tloop	5000 RPM Tloop stable			



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	TTCB EMC/EMI operation procedure sheets		company:		date:	
	Fill in by hand.		engineer:		location:	
Step	Action	Monitoring	Value	Result	Comment	√
18.	Wait until Tacc = Tsetpoint	RMP , Pt01	5000 RPM Pt01=Tsetpoint			
19.	Set pump to 3500 RPM	Pump RPM	3500			
20.	Execute “EMC pump test”, monitor Taccu , system pressure, Tmpmp_inlet	Taccu Psystem Pt02	Taccu < 25 °C P < 65 bar Pt02<Taccu – 3			
21.	If Pt01 or pressure too high then stop “EMC pump test”, cool down EMC test chamber, repeat step 16-18 for cooling down TTCB hw and continue test	Tenv	Tenv ≤ 20°C			
22.	Set pump to 6000 RPM	Pump RPM	6000 RPM			
23.	Execute “EMC pump test”, monitor Taccu , system pressure, Tmpmp_inlet	Taccu Psystem Pt02	Taccu < 25 °C P < 65 bar Pt02<Taccu – 3			
24.	If Pt01 or pressure too high then stop “EMC pump test”, cool down EMC test chamber, repeat step 16-18 for cooling down TTCB hw and continue test	Tenv	Tenv ≤ 20°C			
25.	Set pump to 10000 RPM	Pump RPM	10000 RPM			



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Fill in by hand.		engineer:		location:		
Step	Action	Monitoring	Value	Result	Comment	√
26.	Execute “EMC pump test”, monitor Taccu , system pressure, Tmpmp_inlet	Taccu Psystem Pt02	Taccu < 25 °C P < 65 bar Pt02<Taccu – 3			
27.	If Pt01 or pressure too high then stop “EMC pump test”, cool down EMC test chamber, repeat step 16-18 for cooling down TTCB hw and continue test	Tenv	Tenv ≤ 20°C			
Pre-heater test						
28.	Set accumulator set point, automatic control	Taccu	T=Tenv + 2 °C			
29.	Switch on TTCB pump for cooling down TTCB hw until TTCB is cooled down	RMP , Tloop	5000 RPM Tloop stable			
30.	Switch off accu control (heater & peltier), set pump RPM to minimal flow, switch on pre-heater automatic control	Accu controll Pump RPM Pre-htr control	OFF 2500 ON			
31.	Execute “EMC pre-heater test”, monitor Taccu , system pressure, Tmpmp_inlet	Taccu Psystem Pt02	Taccu < 25 °C P < 65 bar Pt02<Taccu – 3			
32.	If Pt01 or pressure too high then stop “EMC pre-heater test”, cool	Tenv	Tenv ≤ 20°C			



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Fill in by hand.			engineer:		location:	
Step	Action	Monitoring	Value	Result	Comment	√
	down EMC test chamber, repeat step 28-29 for cooling down TTCB hw and continue test					
	Start up heater test (SUP)					
33.	Set accumulator set point, automatic control	Taccu	T=Tenv + 2 °C			
34.	Switch on TTCB pump for cooling down TTCB hw until TTCB is cooled down	RMP , Tloop	5000 RPM Tloop stable			
35.	Swich off accu control (heater & peltier), set pump RPM to minimal flow	Accu control Pump RPM	OFF 2500			
36.	Execute “EMC start-up heater test”, monitor Taccu , system pressure, Tmp_inlet. Manual switch on / off (2s / 10s) SUP	Taccu Psystem Pt02	Taccu < 25 °C P < 65 bar Pt02<Taccu – 3			
37.	If Pt01 or pressure too high then stop “EMC start-up heater test”, cool down EMC test chamber, repeat step 33-34 for cooling down TTCB hw and continue test	Tenv	Tenv ≤ 20°C			
	Cold orbit heater test					
38.	Set accumulator set point, automatic control	Taccu	T=Tenv + 2 °C			



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Fill in by hand.		engineer:		location:		
Step	Action	Monitoring	Value	Result	Comment	√
39.	Switch on TTCB pump for cooling down TTCB hw until TTCB is cooled down	RMP , Tloop	5000 RPM Tloop stable			
40.	Switch off accu control (heater & peltier), set pump RPM to minimal flow	Accu control Pump RPM	OFF 2500			
41.	Execute “EMC COH test”, monitor Taccu , system pressure, Tmp_inlet. Manual switch on / off (2s / 10s) COH	Taccu Psystem Pt02	Taccu < 25 °C P < 65 bar Pt02<Taccu – 3			
42.	If Pt01 or pressure too high then stop “EMC COH test”, cool down EMC test chamber, repeat step 38 - 40 for cooling down TTCB hw and continue test	Tenv	Tenv ≤ 20°C			
43.						



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